

## TDM Success Stories

### *Examples of Effective Transportation Demand Management Policies and Programs, and Keys to Their Success*

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### **Abstract**

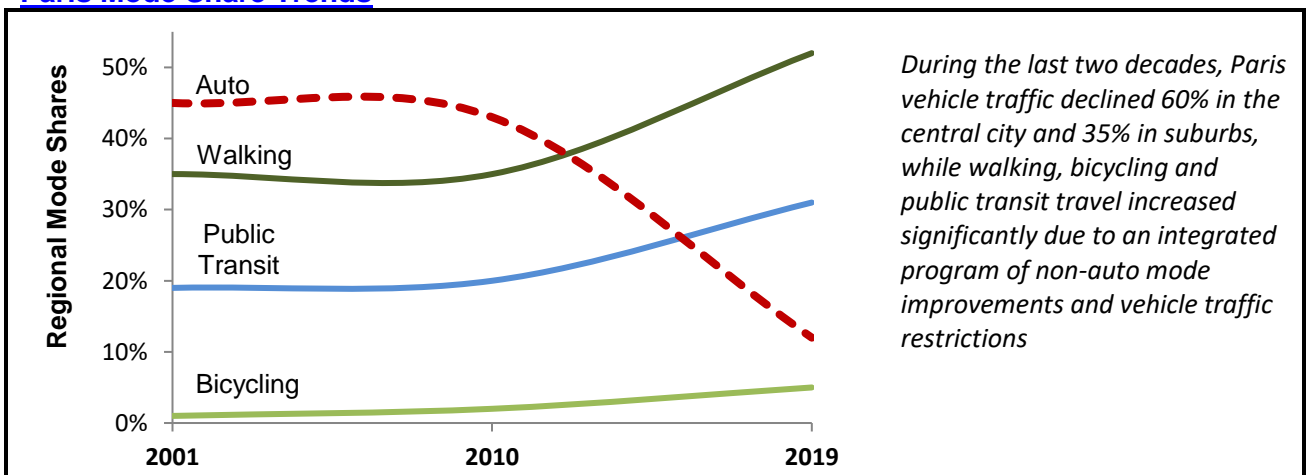
Transportation Demand Management (TDM) refers to policies and programs that increase transportation system efficiency. They include improvements to resource-efficient modes (walking, bicycling and public transit), incentives to choose the most efficient option for each trip, and Smart Growth development policies that create compact, multimodal communities. Some people are skeptical; they claim that TDM is difficult and costly, citing examples of ineffective or expensive programs. This report investigates TDM effectiveness. It describes examples of successful TDM programs, discusses how to evaluate their full benefits, and identifies keys to their success. These examples indicate that well-designed TDM policies and programs can cause significant travel changes and provide many benefits to travellers and communities. When all impacts are considered, TDM is often the most cost-effective and beneficial way to improve transportation.



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## Paris Mode Share Trends



## 1. Introduction

*Transportation Demand Management* (TDM, also called mobility management or VMT reductions) refers to policies and programs that encourage travellers to use the most efficient option for each trip. Table 1 lists various types of TDM strategies.

**Table 1** TDM Strategies ([CARB 2015](#), [Kuss & Nicholas 2022](#), [VTPI 2020](#))

| Improves Transport Options                            | Incentives to Use Efficient Options                                       | Smart Growth Policies   | Implementation Programs                |
|---|---|---|--|
| Active transport (walking and bicycling) improvements | Commuter financial incentives (parking cash out, transit subsidies, etc.) | Complete streets  | Commute trip reduction programs        |
| Public transit improvements                           | Efficient parking pricing   | Smart growth/New Urbanism                                     | Freight transport management           |
| Rideshare programs                                    | Reduce or eliminate parking minimums                                      | Transit Oriented Development (TOD)                            | Mobility management marketing          |
| High occupancy vehicle (HOV) lanes                    | Parking unbundling  | Location-efficient development                                | School and campus transport management |
| Taxi & ridehailing improvements                       | Efficient road pricing  | Reduced parking requirements and efficient parking management | Tourist transport management           |
| Car- and bikesharing                                  | Fuel and carbon taxes   | Streetscaping   | Transport planning reforms             |
| Guaranteed ride home                                  | Vehicle taxes and fees  | Traffic calming   |  |
| Closer commuting                                      | Distance-based insurance and registration fees                            |   |  |
| Telework and flextime                                 |   |   |  |

*This table lists various transportation demand management strategies.*

There are many reasons to implement TDM. Demand management is often the most cost-effective solution to problems such as traffic and parking congestion, inadequate mobility for non-drivers, traffic risk and pollution emissions. It can reduce infrastructure costs to developers and governments. Many TDM strategies directly benefit travellers, particularly those who cannot, should not or prefer not to drive, and so helps achieve social equity goals. TDM tends to increase public health and safety, and help achieve community livability goals. It can support strategic objectives such as affordability, openspace preservation, energy conservation and local economic development. Many TDM strategies increase economic efficiency and opportunity.

In the past, transportation planners often implemented TDM as a solution of last resort, to be implemented when roadway expansions were infeasible. However, it is increasingly being considered as a way to achieve various goals including social equity, traffic safety, public health, community livability and emission reduction targets. Many communities have vehicle travel reduction targets which prioritize TDM over roadway expansions (Caltrans 2020; Litman 2022).

However, TDM often faces skepticism. Some practitioners claim that TDM has been tried but failed, citing examples of underused car-pool lanes or bicycle encouragement programs that appeared to have little impact. Such examples are incomplete and unfair. In fact, many TDM programs have proven to be cost effective and beneficial. This report describes various successful TDM programs, evaluates their costs and benefits, and identifies keys to their success. This should be of interest to planning practitioners, policy makers, developers and other stakeholders who want to implement innovative and effective TDM programs.

## 2. School and Campus TDM Programs

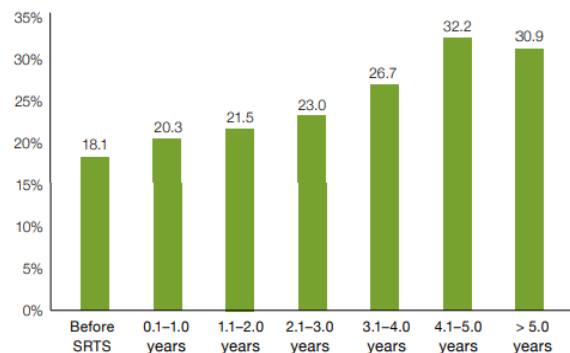
Many schools, colleges and universities are implementing transportation demand management programs to reduce traffic and parking problems. These typically include active and public transit service improvements, U-pass (the campus purchases highly-discounted transit service for all students), more accessible campus design, bike- and car-sharing, and efficient parking pricing. They often reduce automobile trips to campus by 20-50%.

### **Safe Routes to School Programs** (<http://bit.ly/3YywJhm>)

Safe Routes to School (SRTS) is an international movement to make walking and bicycling to school safe, convenient and fun in order to improve student's health and learning readiness, unite neighborhoods, and reduce traffic problems and pollution. These programs typically increase non-auto mode shares by 50% to 100% and since automobile chauffeuring trips often involve empty backhauls, they provide relatively large reductions in automobile travel and costs.

**Figure 1** Walking and Bicycling to School by SRTS Program Duration ([SRTS 2015](#))

*A study of 801 schools in the District of Columbia, Florida, Oregon, and Texas found that Safe Routes to Schools (SRTS) programs typically increase active travel 50% to 100%, and reduce automobile trips about 10-20% reduction, with impacts that increase over time. Since chauffeuring trips often involve empty backhauls, this provided proportionately larger VMT reductions. For more information see the [SRTS Case Studies and Success Stories](#) website.*



### **Stanford University's Congestion and Parking Relief Incentives** ([CAPRI](#))

Stanford University implemented its comprehensive TDM program in an agreement with the local government to eliminate the requirement for traffic impact studies and mitigation for campus development (more classrooms, laboratories, research institutes and housing) provided there is no net increase in total vehicle trips. As a result, drive alone rates declined from 72% to 46% for staff, and are just 39% for all university commuters including students. This allowed construction of millions of square feet of additional building space that accommodate more students and staff without expanding roads and parking facilities.

### **AccessMIT Program** ([Rosenfield, Attanucci and Zhao 2020](#))

In 2016, the Massachusetts Institute of Technology launched Access MIT, a TDM program to reduce campus parking and traffic problems. It changed parking prices from annual passes to daily fees with an annual maximum. This reduced total parking transactions 10%. Success was measured as the extent to which drivers decreased their frequency of parking and increased their use of alternative modes during and after the campaign.

*“By reducing the parking transactions, MIT has been able to defer additional parking garage construction. In fact, a 400-space parking garage was recently demolished to build a dormitory, and 17 percent of the group that used that parking lot ultimately decided not to renew their permit.”*



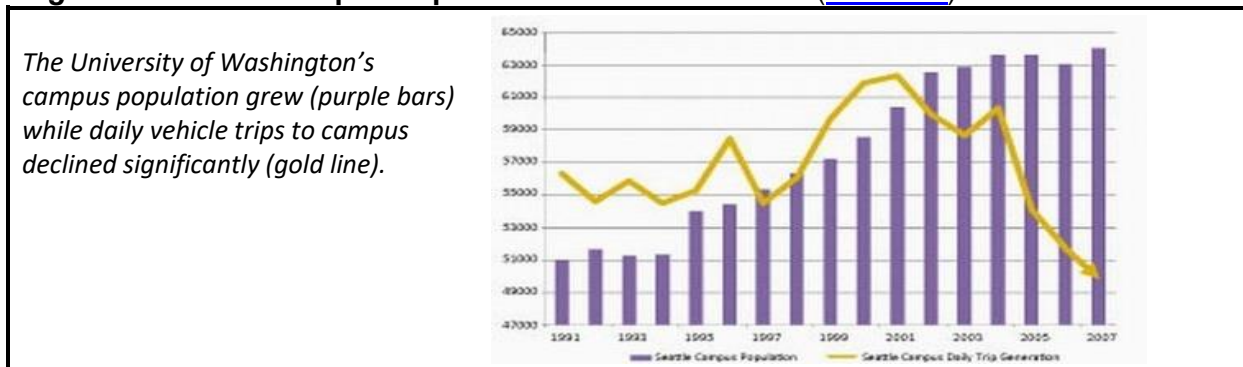
### UC Berkeley Flexpass Program (<http://bit.ly/3L2yz70>)

To help alleviate parking problems, the University of California, Berkeley tested a *FlexPass* which offered selected participants incentives for parking less and shifting modes. This resulted in a 4.2% drop in parking demand among commuters offered rebates as compared with a control group. This program demonstrated the feasibility of parking pricing reforms to reduce parking and traffic problems and free up campus parking lots for other uses.

### University of Washington U-Pass Program

The University of Washington's goal is for drive-alone commutes to account for only 12% of all trips to campus. To achieve that goal it has an integrated trip reduction program that includes walking and bicycling improvements, subsidized U-passes, and efficient parking fees. A 2018 survey found that about 78% of all UW community members had used transit within a week, and only 19% of total trip to campus are by single occupant vehicle ([Northwest Group 2019](#)).

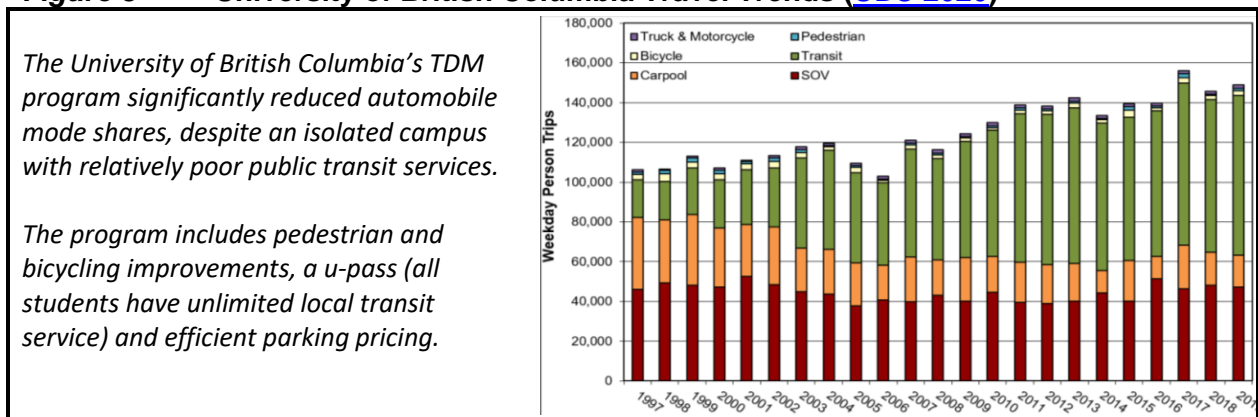
**Figure 2 UW Campus Population and Travel Trends ([UW 2008](#))**



### UBC TDM Program

The University of British Columbia has goals to encourage sustainable modes and reduce automobile trips through a comprehensive TDM strategy. The figure below illustrates the results. Between 1997 and 2019 total person trips increased 40%, from 106,100 to 148,800, single occupant trips only increased 3%, from 46,000 to 47,300. This occurred despite the fact that the campus is geographically isolated and transit service is poor, consisting of buses that largely operate in mixed traffic and are often crowded.

**Figure 3 University of British Columbia Travel Trends ([UBC 2020](#))**

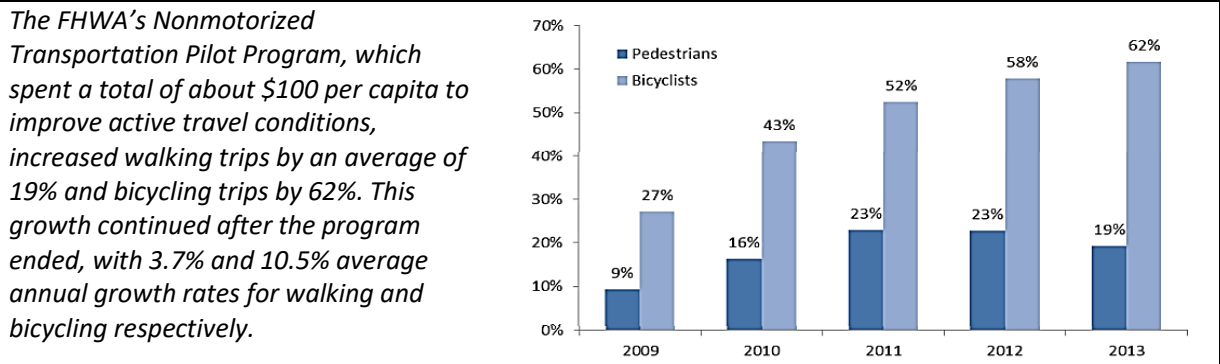


### 3. Local and Regional TDM Programs

#### Active Transportation Programs

The U.S. Federal Highway Administration produced a comprehensive evaluation of its four-year Nonmotorized Transportation Pilot Program. The program invested about \$100 per capita in pedestrian and cycling improvements in four typical communities (Columbia, Missouri; Marin County, Calif.; Minneapolis area, Minnesota; and Sheboygan County, Wisconsin), which increased walking trips 23% and bicycling trips 48%, and reduced driving about 3%. It increased public safety and health, and reduced fuel consumption and emissions.

**Figure 4** Percentage Change in Walking and Bicycling Trips ([FHWA 2014](#))

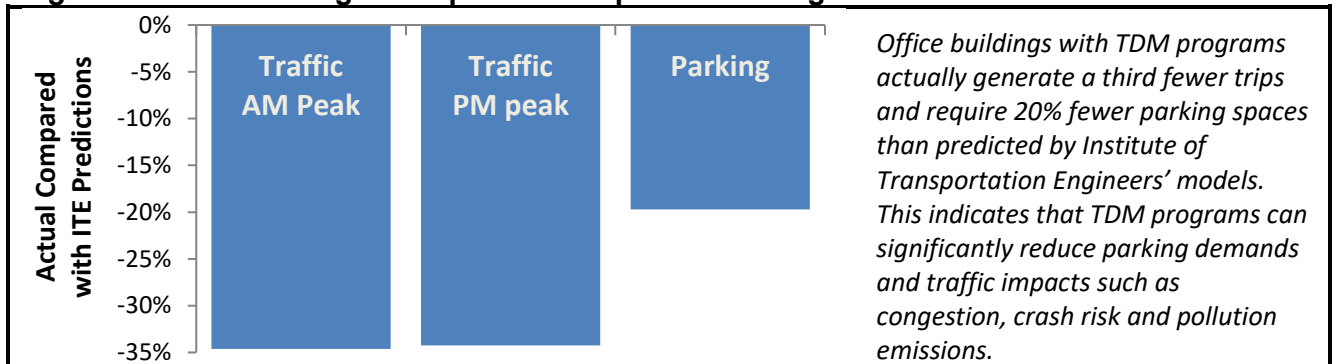


Recent research indicates that a 10% increase in per capita bikeway-miles increases bicycle commute mode share 2.5%, and 4% if they consist of protected bicycle lanes (Yang, et al. 2021). Cities with extensive active mode networks, such as Davis, California; Eugene, Oregon; and Boulder, Colorado have more than 15% active commute mode shares, five times the national average, and much lower per capita VMT than the national averages ([Buehler 2016](#)).

#### Minneapolis-St. Paul TDM Program ([Spack and Finkelstein 2014](#))

A detailed study, *Travel Demand Management: An Analysis of the Effectiveness of TDM Plans in Reducing Traffic and Parking* measured trip generation at nine typical office buildings in the Minneapolis-St. Paul metropolitan region. It found that office buildings that implemented TDM plans generate, on average, 34% to 37% less traffic and need 17% to 24% fewer on-site parking spaces than Institute of Transportation Engineers' predicted rates, as illustrated below.

**Figure 5** TDM Program Impacts on Trips and Parking Demands

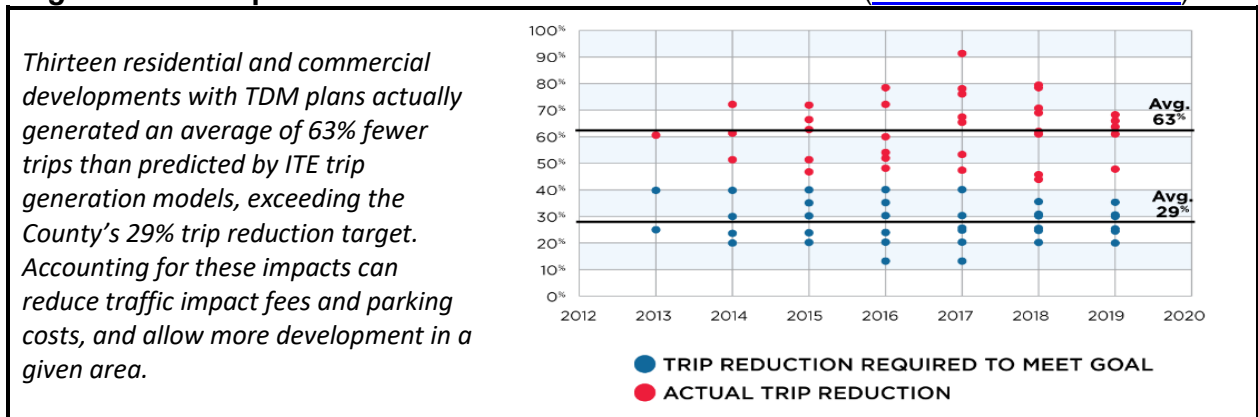


### Suburban TDM Program, Fairfax County ([Galdes and Schor 2022](#))

Fairfax County has ambitious vehicle trip reduction goals. The study, *Don't Underestimate Your Property: Forecasting Trips and Managing Density over the Long Term*, found that 13 residential and commercial developments with TDM programs actually generate 63% fewer trips than trip generation models predict, more than double the targets. As one traffic engineer explained,

“Overestimating trip generation can have deleterious effects on a neighborhood because trip generation is so closely linked to the amount of square footage that a property is allowed. More than any other feature of a development, vehicle trip generation estimates determine density limits and impacts.” (Mike Workosky, traffic engineer and President of Wells + Associates)

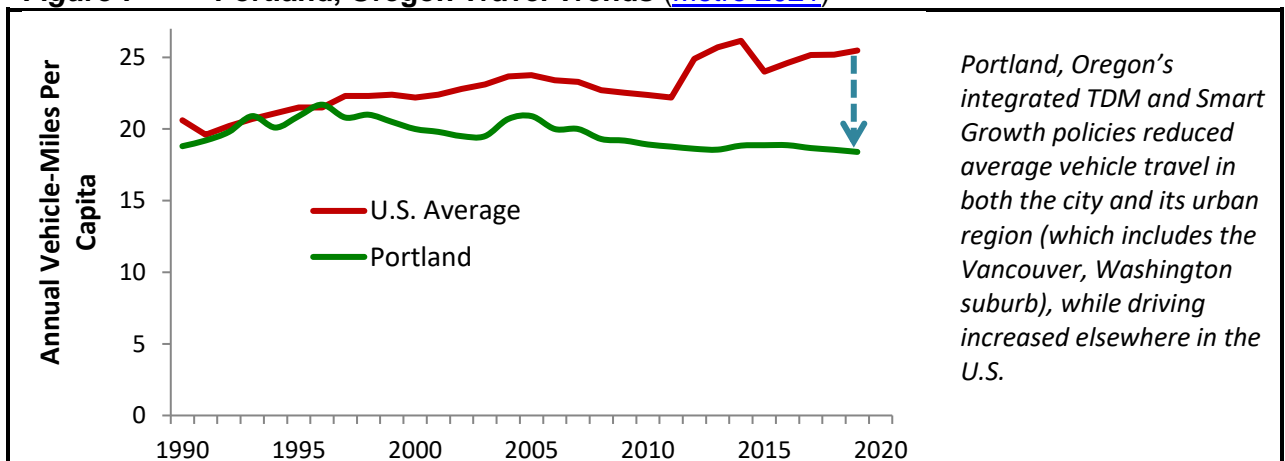
**Figure 6 Trip Generation Reductions due to TDM Plans** ([Galdes and Schor 2022](#))



### Portland, Oregon Mode Shift

Some North American urban regions have implemented integrated vehicle travel reduction programs that significantly reduce per capita vehicle travel. For example, during the last two decades, the city of Portland shifted highway expansion funding to improve regional bus and rail transit services, implemented TDM programs, reformed its parking policies, and implemented Smart Growth policies that encourage more compact development. As a result, per capita vehicle travel declined in that region while it increased nationally, resulting in average per capita vehicle travel nearly 30% lower than the U.S. average, as illustrated in the following graph.

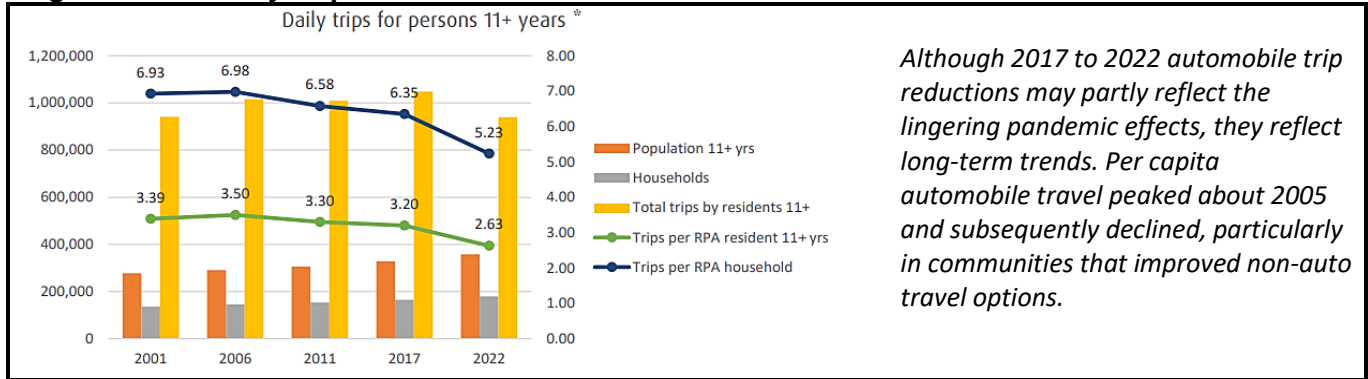
**Figure 7 Portland, Oregon Travel Trends** ([Metro 2021](#))



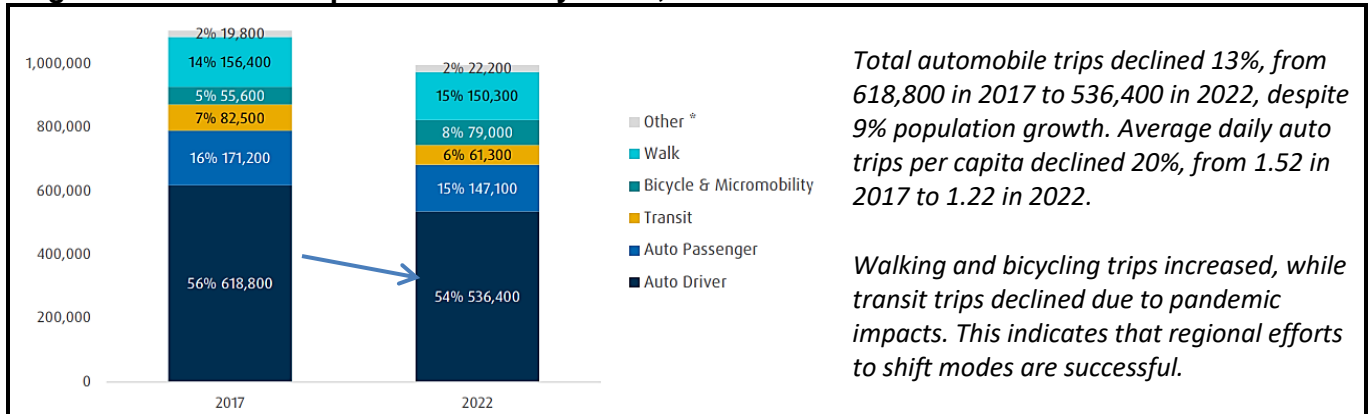
### Capital Regional Vehicle Travel Reductions (Litman 2024)

A series of travel surveys show that driving declined and active travel increased in the the Capital Regional District (greater Victoria, British Columbia), as illustrated in these graphs. These changes indicate significant progress toward regional travel goals, and provide large economic, social and environmental benefits.

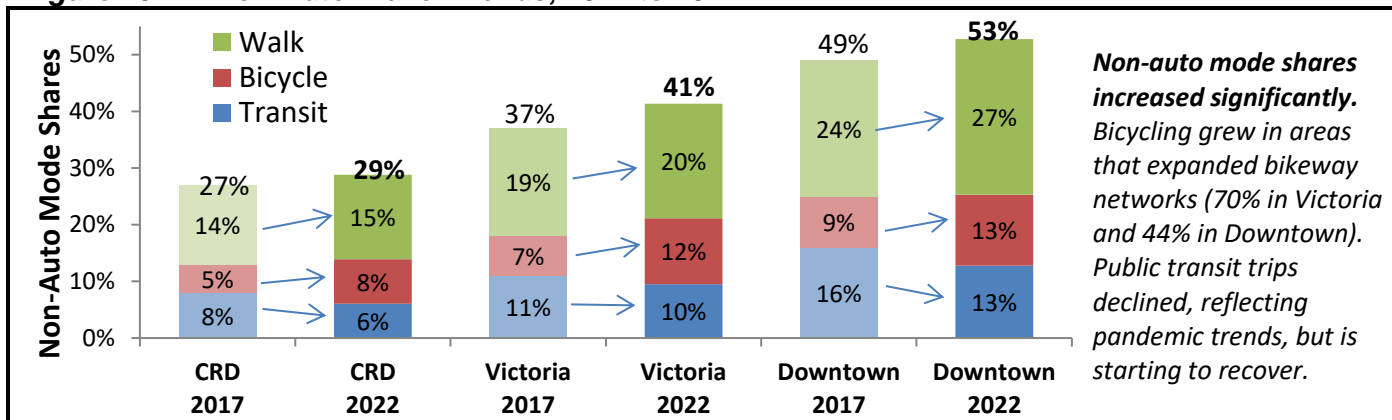
**Figure 8 Daily Trip Trends**



**Figure 9 Total Trips and Shares by Mode, 2017 to 2022**



**Figure 10 Non-Auto Travel Trends, 2017 to 2022**

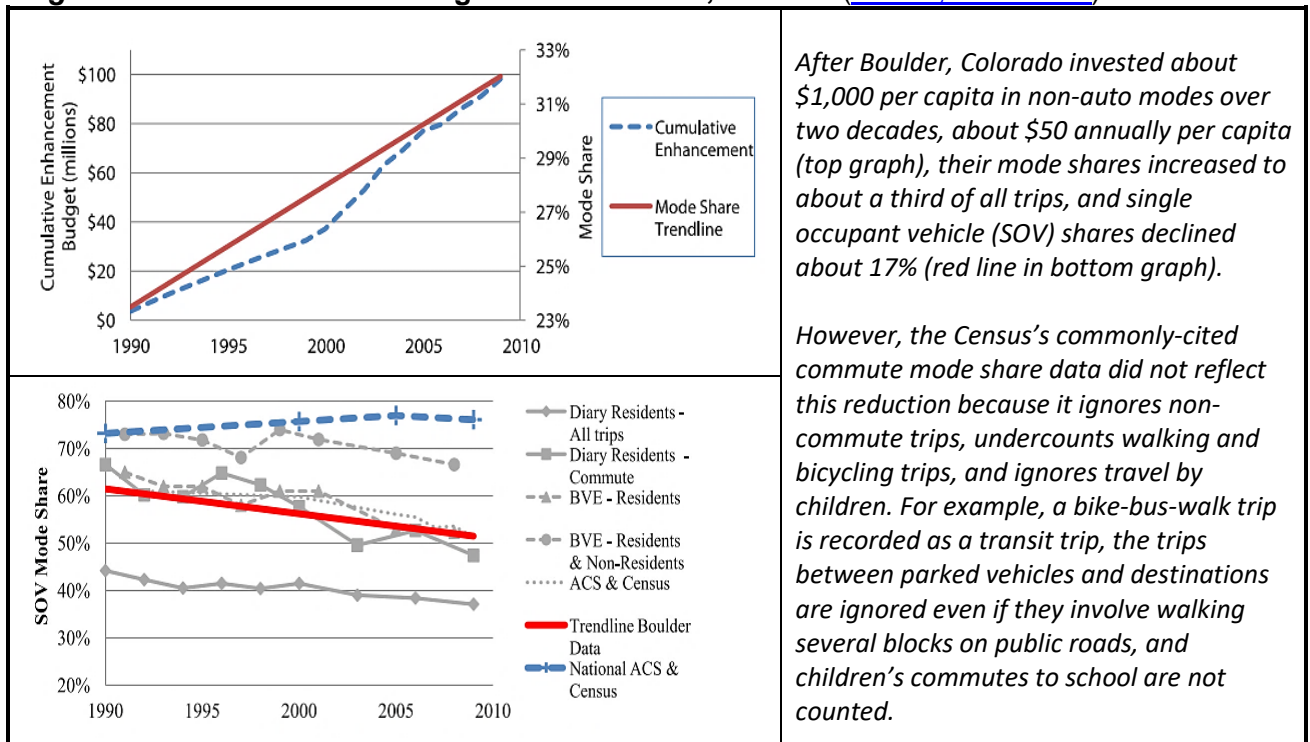




### Boulder, Colorado Mode Shifts

The study, “Sustainable Transportation Infrastructure Investments and Mode Share Changes: A 20-Year Background of Boulder, Colorado,” shows that after the city increased non-auto mode investments their mode shares increased and automobile travel declined, as illustrated below.

**Figure 8 Non-Auto Funding and Mode Share, Boulder** ([Henao, et al. 2015](#))

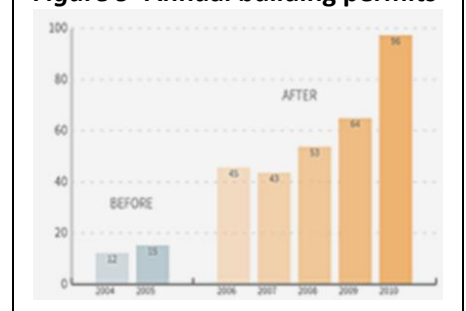


### Complete Streets ([SGA 2023](#)) and Streetscaping ([Schlossberg, et al. 2013](#))

*Complete streets* refers to urban roadways designed to accommodate diverse users and uses including pedestrians, bicyclists, transit, and automobiles, plus commercial and recreational activities.

*Streetscaping* refers to roadway design changes to improve function and livability. Numerous case studies demonstrate that complete streets can improve traffic safety and create more attractive urban environments, which tends to increase investment and business activity. For example, after a “Main Street” project in Hamburg, New York, annual building permits increased from 15 to 96, as illustrated to the right (Schlossberg, et al. 2013).

**Figure 9 Annual building permits**

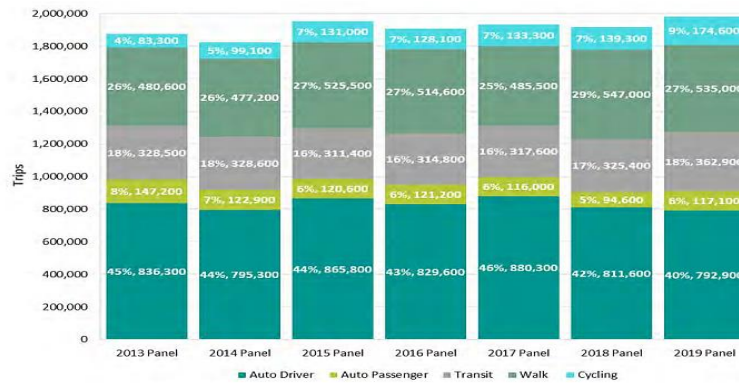


### Vancouver TDM Programs

The City of Vancouver, British Columbia’s Climate *Emergency Action Plan* ([Vancouver 2020](#)) and *Strategic TDM Plan* ([Vancouver 2021](#)) have ambitious vehicle travel reduction targets. The city and region are improving pedestrian and bicycling facilities, improving public transit services, encouraging compact development, and supporting employee and school transportation management programs. The city’s [Transportation Panel Surveys](#) show that between 2013 and 2019 automobile mode shares declined 12% of total trips and 11% for commute trips, while transit shares held steady, and walking and bicycling increased significantly, as illustrated below.

**Figure 10** Total Trips by Mode, 2013-2019 ([Vancouver, BC 2021](#))

Between 2013 and 2019 automobile mode shares declined from 45% to 40% of total trips, and from 38% to 34% of commute trips, transit shares held steady, and walking and bicycling increased significantly

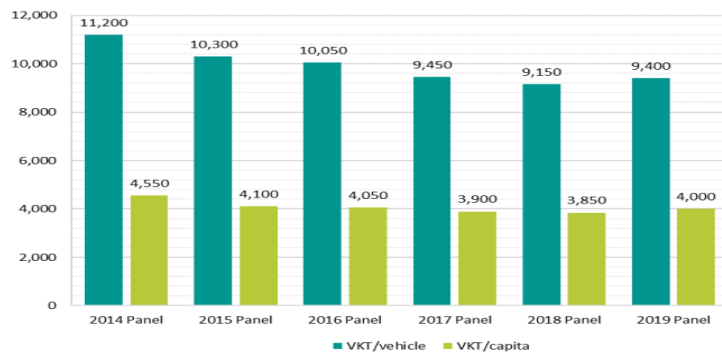


Even more dramatic is the significant reduction in kilometres travelled per vehicle (16%) and per capita (12%) between 2014 and 2019 (ignoring the 2020 pandemic year), illustrated below.

**Figure 11** Vehicle-Kilometers per Vehicle and per Capita ([Vancouver 2021](#))

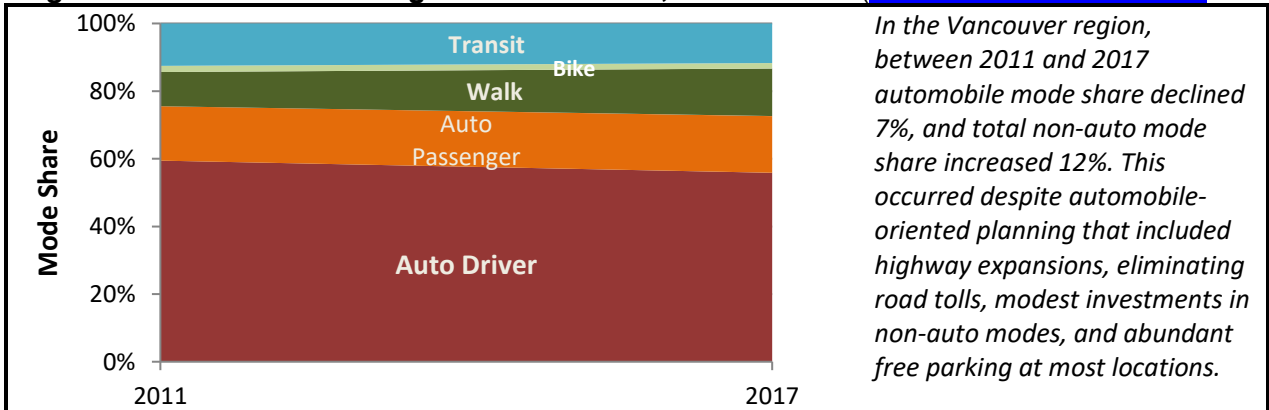
Between 2014 and 2019, vehicle kilometers per capita and per vehicle declined 16% and 12% respectively.

These result from local and regional TDM strategies including active and public transport improvements, and more compact development.



At the regional level, automobile driver mode shares declined from 59% in 2011 to 55% in 2017, and non-auto modes — public transit, walking, and cycling — increased from 24% in 2011 to 27% in 2017, as illustrated below. This, despite the fact that regional transportation planning continues to be automobile-oriented, with major highway expansions, the removal of bridge tolls, only modest investments in non-auto modes, and parking mandates in most locations.

**Figure 12** Vancouver Region Mode Shares, 2011 to 2017 ([Translink Trip Diary 2017](#))

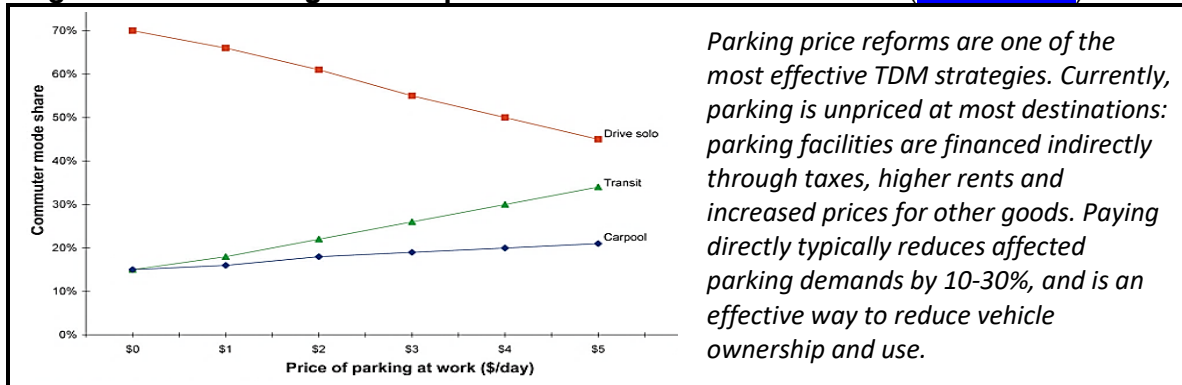


In the Vancouver region, between 2011 and 2017 automobile mode share declined 7%, and total non-auto mode share increased 12%. This occurred despite automobile-oriented planning that included highway expansions, eliminating road tolls, modest investments in non-auto modes, and abundant free parking at most locations.

### Parking Pricing Reforms (PRN)

One of the most effective TDM strategies is efficient parking pricing. This can include imposing and increasing parking fees; *cash out* (non-drivers receive the cash equivalent of parking subsidies provided to motorists); *unbundling* (renting parking separately from building space, so rather than paying \$2,200 for an apartment with “free” parking, renters pay \$2,000 per month for the apartment plus \$200 per month for each parking space they use); and *responsive parking prices* (prices increase with demand and are lower at other times and places).

**Figure 13** Parking Price Impacts on Commute Mode Shares ([Shoup 2005](#))



### Boston and Chicago TDM Plans ([Boston 2021](#) and [CDOT 2023](#))

To reduce traffic problems, the cities of Boston and Chicago limit parking supply in some locations, and require large developments to have TDM plans. They each produced a list of potential TDM strategies and provide tools for evaluating and selecting them for particular locations. Developers sign contracts which specify their TDM implementation responsibilities.

### Bus Rapid Transit Successes ([GTT 2019](#))

Many cities around the world, including some in the U.S., are building bus rapid transit (BRT) systems which improve bus service convenience, speed, and integration ([ITDP](#)). These can significantly increase transit performance and ridership. For example, during its first year, Richmond, Virginia’s *Pulse* BRT line carried 7,000 daily passengers, twice the expected ridership, and increased system wide transit trips 17% ([Cline 2019](#)). New York City’s 14<sup>th</sup> Street Transit and Truck Priority (TTP) project included dedicated lanes, enhanced bus operations (off-bus payment), and street design changes to favor buses and trucks on an urban arterial ([Beer, Miketa and Schack 2023](#)). The year following the project’s completion bus travel speeds increased 24%, bus ridership increased 14%, and injury crashes declined 42%.

### Austin Texas Parking Benefit District ([Kindler 2022](#))

To promote infill development, Austin, Texas reduced parking requirements, which led to more housing but created parking problems on some streets. To address this, in 2006 the city implemented a pilot Parking Benefit District (PBD) with 96 meters. They generated \$163,000 the first year, of which \$40,000 was spent on neighborhood enhancements, such as sidewalk, benches and bike lanes, that increase local livability, safety, business activity and tax revenues. In 2012 the city added 254 meters, and in 2014 expanded it into a *Parking and Transportation Management District* which funds local sustainable transportation and recreational projects.

### Denver E-Bike Program ([McLean 2023](#))

Denver, Colorado's 2020 e-bike program offered residents \$400 to \$1,200 vouchers to purchase electric bikes. In total, 9,500 people applied and 4,734 received vouchers, of which 67% were lower-income. After nine months recipients reported riding their e-bikes 26 miles per week on average, replacing 3.4 round-trip automobile trips. Lower-income participants used their e-bikes nearly 50% more than average, and 29% indicating they were new bike riders. Of recipients who used a phone app to track their travel, 65% rode daily and 90% rode weekly, averaging 3.3 miles per trip. This indicates that the e-bikes reduced at least 22 weekly vehicle-miles or about 20% of total vehicle travel, and probably more since bicycle trips often leverage proportionately longer vehicle trips, for example, if a bicycle shopper chooses a closer store than they if they drove, or if a bike trip substitutes for two chauffeuring trips with empty backhauls (see box below).

#### **Box 1 Non-Auto Mode Leverage Effects** ([Litman 2023](#))

Walking, bicycling and public transit improvements often leverage additional automobile travel reductions, so each additional mile of travel by these modes reduce more than one vehicle-mile of travel.

- *Shorter trips.* Shorter non-auto trips often substitute for longer motorized trips, such as when people choose local shops rather than driving to distant big box stores or regional malls.
- *Reduced chauffeuring.* Improving non-auto modes reduces motorists' need to make special trips to chauffeur non-drivers. These often have empty backhauls (travel with no passenger), so a mile of avoided chauffeuring often reduces two vehicle-miles.
- *Improved public transit travel.* Since most transit trips include walking and bicycling links, improving these modes supports public transit travel and transit-oriented development.
- *Vehicle ownership reductions.* Improving non-auto travel allows some households to reduce their vehicle ownership, which reduces total vehicle-travel.
- *Lower traffic speeds.* Active travel improvements often involve traffic speed reductions. This makes non-auto travel more time-competitive with driving and reduces total vehicle travel.
- *More compact development.* Non-auto modes require much less land for roads and parking, and they help create more attractive urban environments which encourage more compact development.
- *Social norms.* As non-auto travel increases, these modes become more socially acceptable.

### Departure Time Shift

The Bay Area Rapid Transit (BART) Perks pilot program used smartphone app incentives to encourage passengers to shift from crowded to less crowded times and places. Participants shifted between 6% and 20% of their trips. The incentive cost approximately \$1 per shifted trip, which researchers concluded is cost effective compared with expanding peak period capacity.

**Figure 14 Perks Program Travel Changes** ([BART 2019](#))

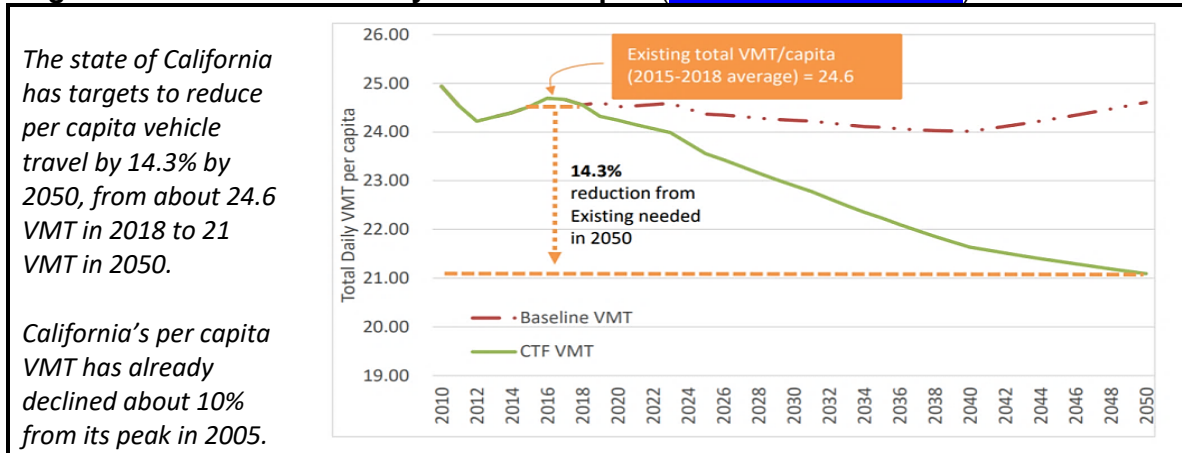
| <i>The Perks Program caused significant shifts from peak to off-peak travel periods.</i> | Change in Share of Travel During Incentivized Periods |                              |
|--|---|------------------------------|
|  | Type of Offer   | Trips in the Transbay Market |
|  | All Participant Trips                                 |                              |
|  | Morning – shift earlier                               | 6%                           |
|  | Morning – shift later                                 | 8%                           |
|  | Afternoon/evening – shift earlier                     | 19%                          |
|  | Afternoon/evening – shift later                       | 14%                          |
|  | Afternoon/evening – shift earlier                     | 13%                          |
|  | Afternoon/evening – shift later                       | 15%                          |
|  |   | 20%                          |
|  |   | 18%                          |

## 4. State TDM Programs

### California SB 743 (CalSTA 2021)

California has targets and plans to achieve carbon neutrality by 2045, in part by reducing per capita light-duty vehicle travel 25% by 2030 and 30% by 2045. To achieve these targets, California law requires that transportation projects be evaluated based on their vehicle travel impacts (Lee and Handy 2018). The California State Transportation Agency developed guidelines for applying these policies to transportation planning decisions (CAPCOA 2021).

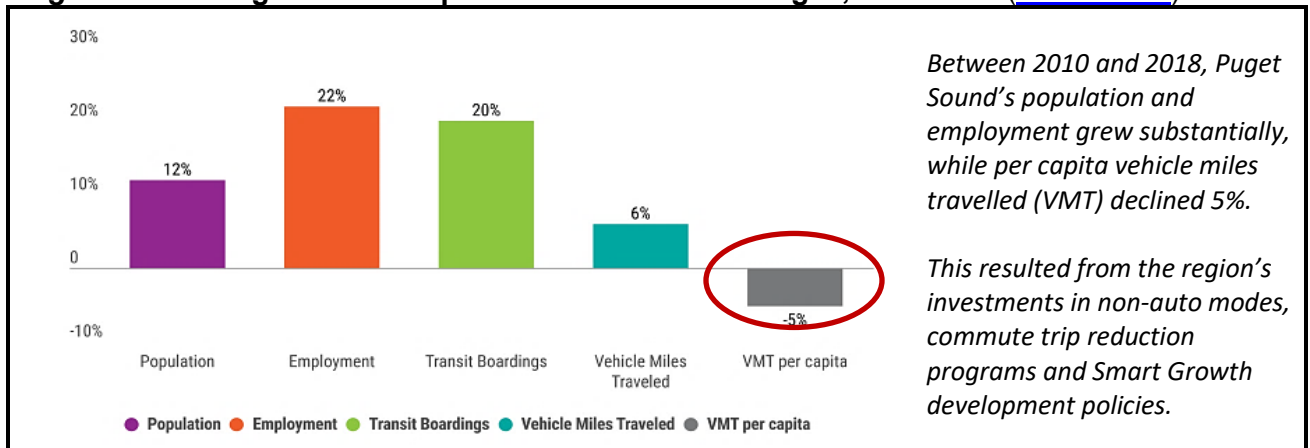
**Figure 15 California Daily VMT Per Capita (Pack and Votsch 2019)**



### Puget Sound Commute Trip Reduction Program

Washington State has targets to reduce per capita vehicle travel 30% by 2035 and 50% by 2050. The state's Commute Trip Reduction (CTR) law, established in 1991, requires large urban employers to develop commute trip reduction plans, and the state supports local, regional and state programs to improve active and public transport services (Jaffe 2015). These policies have reduced Puget Sound region vehicle travel. From 2010 to 2018 regional VMT increased 6%, much less than the 12% population and 22% employment growth; transit boardings increased 20%, and per capita vehicle travel declined 5%, as illustrated below.

**Figure 16 Puget Sound Population and Travel Changes, 2010-2018 (PSRC 2022)**

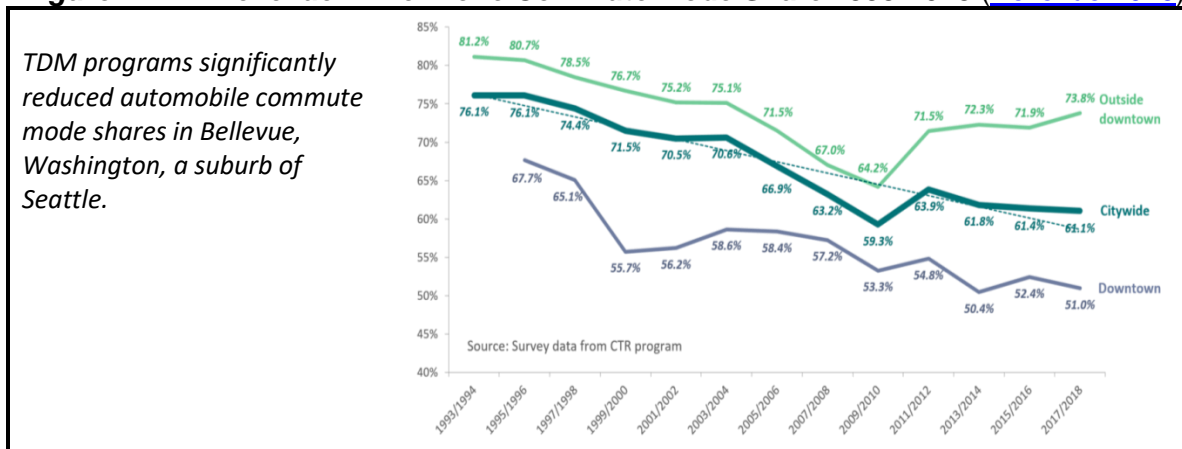




Even larger changes occurred in larger cities. Between 2010 and 2020 Seattle gained more than 65,000 homes, 150,000 residents and 160,000 jobs, but vehicle trips declined more than 5%, vehicle emissions decreased 4%, and downtown automobile commute mode share declined from 35% to 26%. These changes resulted from a combination of active and public transport improvements, the state CTR program and Smart Growth development policies ([SDOT 2020](#)).

Similarly, in the nearby suburb of Bellevue, the [Choose Your Way Bellevue](#) program helps employers draft CTR plans. As of 2019 there were 58 affected worksites with 40,755 workers, including approximately 28% of all workers in the city. From 1993 to 2018, CTR-affected employers' drive alone mode shares decline approximately 20%, from 76% to 61% and, in the City's downtown, declined about 25%, from 68% to 51%.

**Figure 17** Bellevue Drive Alone Commute Mode Share 1993-2018 ([Bellevue 2019](#))



#### Rural Community Transit Rideship ([CRD 2017](#))

Sooke is a rural community with approximately 15,000 residents located 40 kilometers west of Victoria, British Columbia. Between Sooke and Victoria there are 32 daily bus departures with a \$2.50 per trip fare, which serves 12% of total trips and 22% of morning trips on that corridor. In contrast, between the rural community of Duncan and Victoria there are only four weekday buses with \$10 fares, so it is unsurprising that transit serves an insignificant share of trips on that corridor. This indicates that rural residents will use public transit if the service is convenient, frequent and affordable.

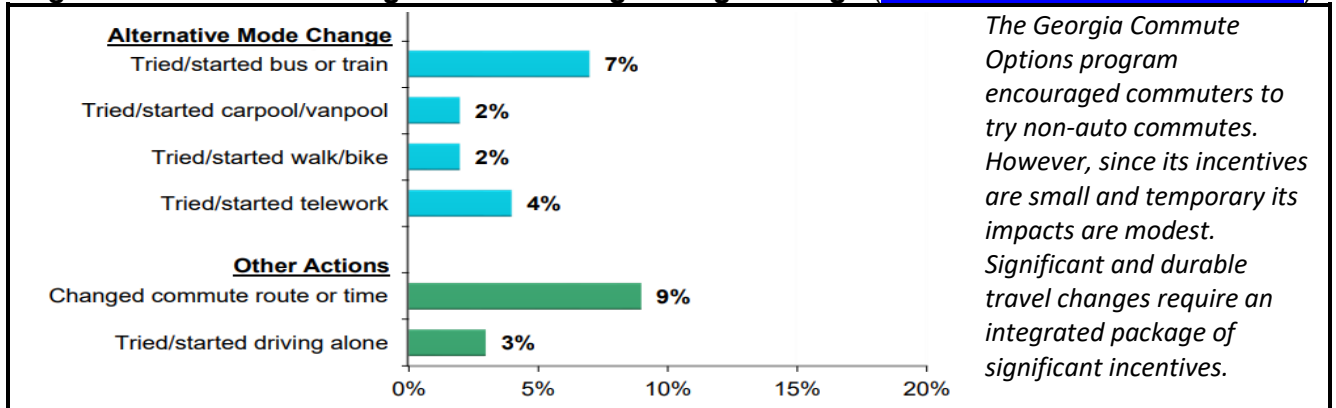
#### CTrides (<https://ctrides.com>)

CTrides is a Connecticut state-wide, worksite-based TDM program. Since it began in 2011 more than 400 employer and stakeholder partners have participated to date. Its rideshare database includes over 50,000 members. Its Drive Less Connecticut Competition ran during May 2018. During that month new members increased 104%, with an overall total of 1,738 active members. BEworks, a team of behavioral scientists, facilitated the program and evaluation to better understand what motivates people to shift mode. According to their evaluation, "To date, CTrides services have led to commuter savings of more than 216 million miles, over 9.8 million gallons of gas, and the prevention of greenhouse gas emissions in excess of 96,000 tons."

### Georgia Commute Options (<https://bit.ly/3L1KUYR>)

Georgia Commute Options is a regional program designed to help commuters switch from driving alone to more resource-efficient options such as walking, bicycling, ridesharing, public transit, teleworking, and compressed work weeks. The incentives and benefits include but are not limited to Gimme Five (\$5 a day for trying an efficient commute option), Vanpool \$50 Referral (\$50 for referring a new vanpool rider after that new rider has completed three consecutive months on a vanpool), and Guaranteed Ride Home (up to five free rides, by taxi or rental car, to their home or car in case of emergency). The figure below summarizes the results.

**Figure 18 Travel Changes After Hearing/Seeing Message** ([Georgia Commute Options 2020](https://bit.ly/3L1KUYR))



### Rural Community Multimodal Planning, Washington State

Some rural communities are implementing multimodal planning to improve affordable and healthy travel options, and help reduce vehicle-travel. For example, Washington State has a *Rural Mobility Grant Program* and a *Travel Washington Intercity Bus Program*. As a result of these resources, most rural counties in Washington State have coordinated public transit services, which provide travel within and between communities. It is possible to travel around the Olympic Peninsula using the Olympic Transit Loop, which consists of six different but coordinated local public transit agencies (Lynott 2014).

**Figure 19 Washington Intercity Bus Network** (<https://bit.ly/3rJcl9n>)



## 5. International Examples

### European Sustainable Urban Mobility Plans ([Eltis 2021](#) and [EU 2021](#))

The European Union's new *Urban Mobility Framework* requires municipal governments to develop Sustainable Urban Mobility Plans (SUMP) by 2025 ([EU 2021](#)). This is intended to help solve air pollution, congestion, accessibility, traffic safety, growth of e-commerce, and other urban mobility challenges. SUMP are multifaceted and tailored to each region's unique needs and abilities. They typically include a combination of active and public transport improvements, roadway and parking design changes, efficient road and parking pricing, development policy reforms, regulatory reforms, improved data collection and program evaluation, and targetted mobility management programs to improve both personal and freight transport efficiency.

To support these plans, the European Union sponsors the *Urban Mobility Observatory* managed by *Eltis*, a network of research organizations that provides extensive, practical guidance on SUMP development ([Eltis 2021](#)). These resources include the *Planner's Guide to Sustainable Urban Mobility Management (SUMP)* a *Toolbox for Mobility Management*, and the *Eltis Case Study Database* which describes in detail numerous, diverse examples from the European Local Transport Information Service. Eltis also provides tailored training on all aspects of the SUMP process and its implementation, improved data collection and evaluation tools, and financial support for implementing and testing innovations.

### Buenos Aires ([ITDP 2016](#))

In 2013, Buenos Aires launched 27 kilometers of bus rapid transit (BRT) services and transformed dozens of city center streets into a pedestrian-friendly environment. Avenue 9 de Julio, known as the "widest avenue in the world" with more than 20 lanes of car traffic, underwent a "transit makeover." The city replaced car lanes with bus-only lanes and created a high-quality, median-aligned bus corridor with 17 stations, accommodating 11 bus lines and improving travel for 200,000 passengers per day. As a result, passengers save an average of 30 minutes per bus ride: trips that previously took 40 minutes now average 14.

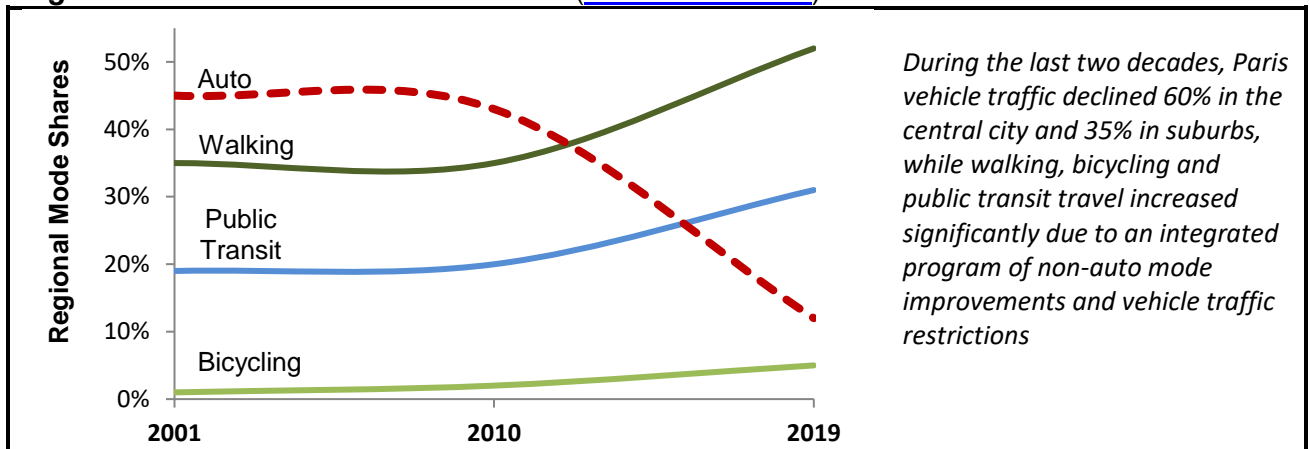
**Figure 20** Before and After Avenue 9 de Julio BRT Service ([ITDP 2016](#))



### Paris Traffic Management

The city of Paris has implemented many sustainable transportation policies (Yeung 2022). During the last two decades it improved public transit services and introduced new mobility options such as bikesharing and electric car-sharing. It is reducing city center parking supply, traffic speeds and vehicle traffic in order to provide more space for pedestrians, bus and bike-lanes, and trees, and to reduce noise and air pollution. It has also banned older cars from downtown neighborhoods during weekdays, reduced car space in parks and squares, and introduced car-free days. Although through traffic is restricted, residents, businesses, visitors and people with disabilities are still allowed to drive on city streets. These policies have reduced vehicle traffic by 60% in the central city and 35% in suburbs (Grabar 2023).

**Figure 21** Paris Mode Share Trends ([C40 Cities 2019](#))



Although the portion of street space devoted to automobile travel is reduced congestion has not increased significantly, indicating that reductions in road supply have been offset by reductions in vehicle traffic. These programs have proven popular with citizens; Mayor Anne Hidalgo easily won re-election in 2020 based on her commitment to continue car traffic reduction programs and improve the city's livability. However, some TDM strategies, such as fuel tax increases, sparked yellow vest ("gilets jaunes") protests led by lower-income motorists in suburban and rural communities. This suggests that additional policies are needed to improve travel options in automobile dependent areas and mitigate the effects of price increases in other ways.

### Brussels ([Balgaranov 2023](#), [Modijefsky 2023](#))

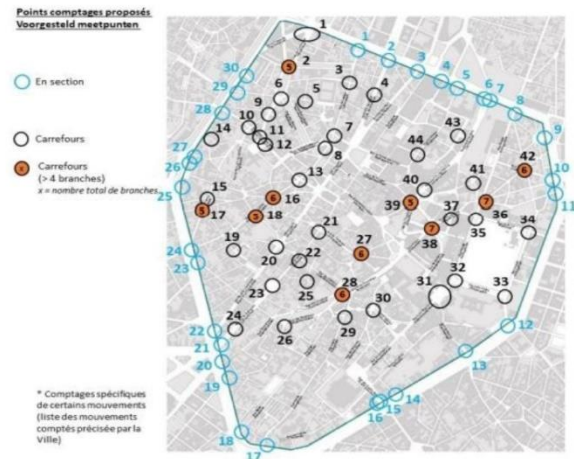
The city of Brussels' *Good Move Plan* limits traffic in the city center. Since the plan was implemented in 2022, total vehicle traffic declined 19%. When it was first introduced, some shop owners protested, concerned that it would cause less traffic and less business. However, the plan subsequently proved successful. Central Brussels now has more walking, bicycling, reduced noise and cleaner air, and less traffic. Bicycling increased 23% during the morning rush hour and 13% in the evening. Travel speed changed little, and improved in some cases. Driving the entire Kleine Ring Road around downtown was five minutes faster after the plan was implemented. This indicates that total traffic declined, called an evaporation effect. According to Alderman Bart Dhondt, who represents the district, "Many people have simply made a different mobility choice and switched to cycling or public transport, for example. The circulation plan thus contributes to the ultimate goal: a more pleasant city for everyone."



**Figure 22** Brussels Good Move Plan ([Brussels 2022](#); [Zipper 2023](#))

The city of Brussels' Good Move Plan changed the flow of traffic in the city's central area. Since the plan was implemented in 2022 total vehicle traffic declined 19%. Only 50% of households own cars, compared with 75% in 2000. Bike trips increased from 3% of trips in 2018 to 10% in 2023. Traffic crashes have dropped, too.

When the plan was first introduced, shop owners protested, concerned that it would reduce business, but objections declined as residents and workers experienced its benefits.



### Reforming Public Transit in Seoul ([Ko 2017](#))

Starting in 2004, Seoul's public transportation reform drastically improved bus routes, fares and management. This transportation reform helped Seoul establish a human-oriented transportation system as shown in increased public transport rider satisfaction and 64% transit mode share. By shifting travel from automobiles to public transit, the city was able to remove a major downtown highway and restore the Cheonggyecheon River as an urban park.

**Figure 23** Before and After Seoul Transportation Reform ([Dutta 2020](#))

Seoul's downtown transportation reforms allowed the city to remove a major highway and restore the Cheonggyecheon River as an urban park.



### Jakarta, Indonesia Sustainable Transport Award ([Mobilize 2021](#))

Jakarta, Indonesia, a city of 10 million in a region of 30 million, won the [2021 Sustainable Transport Award](#) in recognition of its integrated, multimodal planning, including the *Jak Lingko* program that improved urban rail and bus services with integrated physical connections and fares. This increased travel transit travel convenience and speeds and ridership. Jakarta also shifted road space from cars to walking, bicycling and transit facilities, and implementing one of the first urban superblocks in Southeast Asia. In an effort to be more inclusive and address community concerns the city also implemented more participatory planning. For example, in upgrading transit station access, by working with women of the community, they found the biggest concern was safety for school children in the area, resulting in design improvements.



According to the Institute for Transportation and Development Policy's CEO Heather Thompson, "The public enthusiasm for cycling in Jakarta should be a wake-up call for municipal governments everywhere that just building for cars is no longer good enough. The bicycle can be a tool for a movement that allows for distance from others and doesn't contribute to already breathtaking traffic congestion. We are thrilled to celebrate Jakarta over this next year, and we hope to inspire cities around the world to follow in their footsteps."

#### **Carbon Pricing Reforms** ([Döbbeling-Hildebrandt, et al. 2024](#))

A meta-analysis of 21 carbon pricing schemes found that at least 17 achieved statistically significant emissions reductions between -4% to -21%, despite relatively low prices.

#### **Parking Reforms** (ITDP 2023)

The report, *Breaking the Code: Off-Street Parking Reform Lessons Learned*, describes numerous successful examples of integrated off-street parking reforms that have that reduce dependence on driving and help create more compact, affordable, multimodal communities.

#### **Dutch E-cycle Incentive Program** ([de Kruijf, et al. 2018](#))

The Dutch province of North-Brabant launched the "B-Riders" program in 2013 to encourage vehicle commuters to switch to e-bikes. The program provides monetary rewards e-bike commuting. The incentive was initially €0.15 per kilometer during the peak hours and €0.08 per kilometer during off-peak. This shifted 73% of former automobile commuters to e-bikes.

#### **Other Behavior Change Successes**

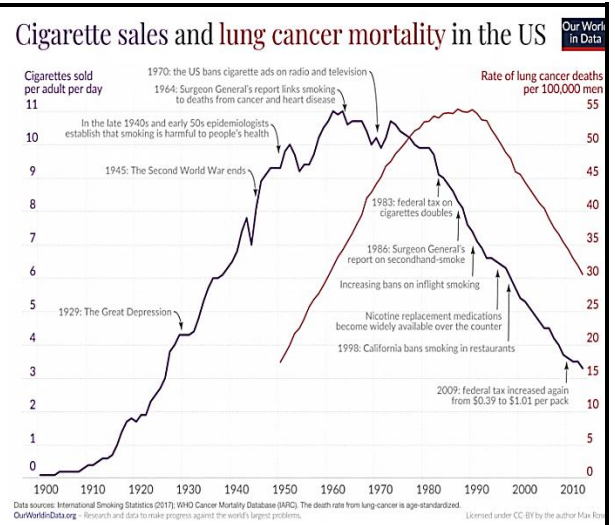
There are many other examples of successful behavior change policies, such as smoking reductions (see below) and pet clean-up. In the past, owners often allowed their pets to defecate on sidewalks, so cities established laws to "curb your dog" (have them defecate on the street curb), but in recent decades it became common for pet owners to collect waste in plastic bags for deposit in public garbage cans; more proof that given encouragement and resources people will change behavior to enhance their health and community livability.

#### **Declining Smoking Rates**

Declining tobacco consumption is an inspiring behavior change success story. During the 1960s most adults smoked cigarettes but by 2019 this had declined to less than 20%, causing lung cancer rates to plummet, as illustrated to the right.

This resulted from integrated public policies that restricted public smoking, increased prices, and provided education and support for smoking secession. These policies were initially criticized as intrusive, unfair, ineffective, and economically harmful; advocates instead promoted "safer" cigarettes. However, once people experienced the benefits, public support grew, including by many former smokers.

Similarly, once people experience multimodal transportation, support tends to grow.



## 6. Impact Summary

The table below summarizes the impact of various TDM strategies. They tend to become more effective and cost effective if implemented in integrated programs.

**Table 2 TDM Effectiveness** ([CARB 2015](#), [Donovan 2023](#); [Kuss & Nicholas 2022](#), [VTPI 2020](#))

| Strategy   | Description  | Typical Travel Impacts   |
|--|--|--|
| <b>Efficient parking pricing and management</b>                          | Charge cost-recovery parking fees with rates that vary by demand. Cash out and unbundle parking. Eliminate parking mandates. | 5-15% reduction in vehicle ownership and 10-30% reduction in affected vehicle trips.   |
| <b>Active and micro modes (walking, bicycling, e-bikes and variants)</b> | Improve walking and bicycling conditions, and encourage use of these modes. Create more compact, walkable neighborhoods.     | Infrastructure improvements increase active and micro mode travel 50-100% and reduce driving 5-15%. Compact, walkable communities reduce driving 20-40%. |
| <b>High quality public transit</b>                                       | Frequent, fast, convenient, comfortable transit services. Amenities such as free wifi, and improved payment systems.         | Service improvements increase affected transit travel 20-50%, and reduce auto travel 5-15%, and sometimes more.  |
| <b>Smart Growth, New Urbanism, Transit-oriented development</b>          | Develop compact, mixed-use neighborhoods around high quality public transit.   | Residents tend to walk, bike and use public transit 20-100% more, and drive 20-60% fewer annual miles.   |
| <b>Commute, school and campus transport management programs</b>          | Improve non-auto travel options and encourage their use with financial incentives (parking pricing and cash out).            | Programs that only use persuasion reduce driving 5-15%, those that provide financial incentives reduce auto trips 10-30%.                                |
| <b>Roadway redesigns to favor sustainable modes</b>                      | Improve sidewalks, add bike- and bus lanes, and reduce traffic speeds. Apply complete streets policies                       | Non-auto travel typically increases 20-100%, and auto travel declines 10-30%. Reducing traffic speeds reduces VMT.                                       |
| <b>Efficient road pricing</b>  | Motorists pay cost-recovery tolls on urban highways and fees to enter city centers   | 10-30% reduction in affected road traffic volumes.   |
| <b>Distance-based pricing</b>  | Vehicle insurance and registration fees are prorated by average annual mileage.  | Up to 15% if total insurance premiums and registration fees are prorated.  |
| <b>Vehicle sharing</b>   | Provide car- and bikesharing services in urban neighborhoods.  | 12-15 private cars replaced by each shared car.  |
| <b>Freight transport management</b>                                      | Require or encourage shippers to use efficient vehicles and logistics.   | Can reduce freight vehicle travel and emissions 10-30%.  |
| <b>Limited traffic zone</b>  | Limit vehicle trips to central city areas.   | 10-20% reduction in city-centre cars.  |
| <b>Personalized travel planning</b>                                      | Residents encouraged to use non-auto modes. Transit fare discounts.  | 6-12% reduction in car use by participants.  |
| <b>Sustainable mobility apps</b>   | Mobile apps provide user information, payments and rewards for reduced driving.  | 73% of app users reduce their vehicle travel.  |

*Vehicle travel reduction strategies can significantly reduce vehicle travel. Their impacts vary depending on design and conditions. They tend to have synergistic effects: they become more effective if implemented as an integrated program that includes a combination of non-auto mode improvements, vehicle travel disincentives (efficient road, parking and vehicle insurance pricing in particular), and Smart Growth development policies that create more compact, multimodal neighborhoods with less free parking.*

## 7. Evaluating TDM Impacts and Benefits

Conventional transport models do a poor job of evaluating TDM impacts and benefits. They are not sensitive to qualitative factors such as travel convenience and comfort, they often use low price elasticities that underestimate pricing reform benefits, and they cannot account for the synergistic effects of multiple TDM strategies, such as improving non-auto modes *plus* efficient parking pricing. They also overlook or underestimate induced travel impacts.

Commonly-used transportation data are inadequate for TDM evaluation. For example, planners often rely on commute mode share data because it is easily available. However, commutes represent less than a fifth of total trips, and these data undercount active mode trips. For example, most commute travel statistics ignore children's commutes to schools; a bike-transit-walk trip is coded simply as a transit trip overlooking the bike and walk links; and trips between parked vehicles and destinations are ignored even if they involve several blocks of walking on public streets. Comprehensive surveys, such as the *National Household Travel Survey*, indicate that about 15% of U.S. trips are by non-auto modes, with much higher rates in cities, which is about twice the amount indicated by commute mode share data.

In addition, conventional transportation project evaluation models tend to overlook many costs of increased automobile travel and many benefits provided by vehicle travel reductions. The table below illustrates this. Urban highway expansions may reduce traffic congestion, at least in the short-run but, by inducing additional vehicle travel, they increase downstream congestion and parking problems, total crashes and pollution emissions. Similarly, shifting from conventional vehicles to more efficient or alternative fueled vehicles can reduce fossil fuel consumption and pollution emissions but, because they have low operating costs, they tend to be driven more annual miles, increasing traffic impacts. In contrast, TDM and Smart Growth improve affordable and resource-efficient travel options, reduce total vehicle travel, and create compact, multimodal communities, which helps achieve numerous planning objectives.

**Table 3** Comparing Impacts of Transportation Policies

| Planning Objective                   | Roadway Expansions | Efficient or Alt. Fuel Vehicles | TDM and Smart Growth |
|--------------------------------------|--------------------|---------------------------------|----------------------|
| <i>Vehicle Travel Impacts</i>        | <i>Increased</i>   | <i>Increased</i>                | <i>Reduced</i>       |
| Traveller comfort and convenience    | Mixed              |                                 | ✓                    |
| Congestion reduction                 | ✓                  |                                 | ✓                    |
| Roadway cost savings                 |                    |                                 | ✓                    |
| Parking cost savings                 |                    |                                 | ✓                    |
| Consumer cost savings                |                    | Mixed                           | ✓                    |
| Independent mobility for non-drivers |                    |                                 | ✓                    |
| Improved traffic safety              |                    |                                 | ✓                    |
| Energy conservation                  |                    | ✓                               | ✓                    |
| Reduced pollution                    |                    | ✓                               | ✓                    |
| Efficient land use                   |                    |                                 | ✓                    |
| Improved fitness & health            |                    |                                 | ✓                    |

(✓ = helps achieve that objective.) Roadway expansion and more efficient vehicles help achieve specific objectives but, by inducing more vehicle travel, they increase traffic problems. TDM and Smart Growth improve travel options and reduce total vehicle travel, which helps achieve multiple objectives and so are often most cost effective solution overall. Comprehensive evaluation should consider all of these impacts.

As a result of these omissions and biases, conventional transportation planning tends to exaggerate the value of roadway expansions and undervalue improvements to non-auto modes, TDM programs, and Smart Growth development policies which create more compact and multimodal communities. More comprehensive analysis tends to justify more TDM investments. For example, conventional transportation project evaluation ignores the additional downstream traffic and parking congestion caused by highway expansions that induce more vehicle travel, and so undervalues active mode and public transit improvements, and TDM incentives that reduce automobile travel. Similarly, conventional evaluation ignores the social equity and health benefits provided by improvements to affordable, inclusive and healthy modes.

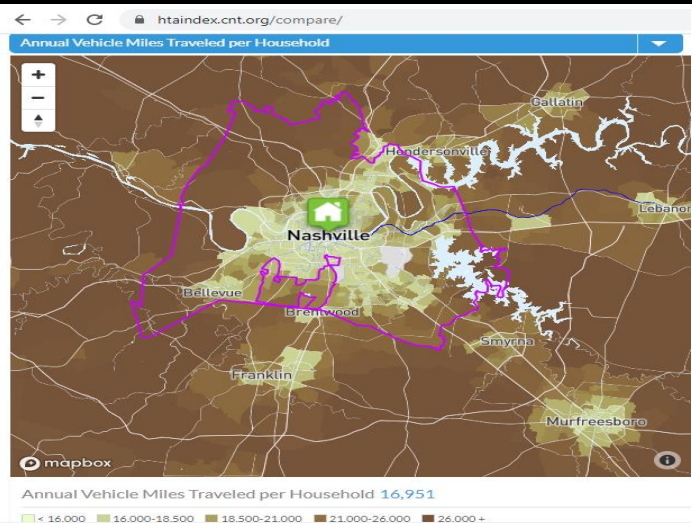
New information resources and models are better at predicting TDM travel impacts.

- The [\*Impacts of Transportation and Land Use-Related Policies\*](#) summarizes TDM vehicle travel reduction results.
- The *TDM+ Tool* ([www.fehrandpeers.com/tdm](http://www.fehrandpeers.com/tdm)) evaluates the TDM real-world effectiveness.
- The *California Vehicle Miles Traveled-Focused Transportation Impact Study Guide* ([Caltrans 2020](#)) provides practical guidance for predicting TDM program vehicle travel impacts.
- The *San Francisco TDM Tool* ([www.sftdmtool.org](http://www.sftdmtool.org)), provide guidance for predicting vehicle travel impacts and how to achieve VMT reduction targets.
- The [\*Smart Growth Trip-Generation Adjustment Tool\*](#) indicates the trip and parking reductions from more compact, multimodal development.
- The *TDM Return on Investment Calculator* (<https://mobilitylab.org/calculators>) calculates the vehicle travel reduced by TDM programs, and to calculate their returns on investments.
- Stuart Donovan's [\*Policies for Sustainable Cities\*](#) identifies specific policies for achieving New Zealand's 20% vehicle-travel reduction targets. (Parking pricing is most effective.)
- The [\*Cool Climate Network\*](#), the [\*Housing and Transportation Affordability Index\*](#), and the [\*Commute Duration Dashboard\*](#) produce heat maps showing per household vehicle-miles, emissions and trip durations, indicating various benefits of infill development.

**Figure 24 Per Household Annual Vehicle-Miles Heatmap (H+T Index)**

Several websites produce heat maps showing how various transportation impacts vary by location. This can help determine where Smart Growth policies and infill development can reduce vehicle ownership and use, and associated costs.

The example at right, from the *Housing and Transportation Affordability Index* (<https://htaindex.cnt.org>) website, illustrates the much lower annual VMT per capita in central neighborhoods in the Nashville, Tennessee.



## 8. Keys to Success

These examples provide insights for effective and beneficial TDM policies and programs.

- To be effective, TDM strategies must respond to traveller demands. That requires comprehensive data on current travel patterns and latent demands for efficient mobility and accessibility options. For example, travellers should be surveyed to understand the obstacles they face in using resource-efficient modes, and possible ways to increase their use.
- The most effective programs include a combination of improvements to non-auto modes, TDM incentives to reduce driving, and Smart Growth development policies that create compact, multimodal communities.
- TDM programs that rely on modest improvements to non-auto modes and promotion campaigns may benefit some users, but generally provide only small vehicle travel reductions. To achieve significant vehicle travel reductions, TDM programs require financial incentives such as efficient parking pricing and parking cash out.
- Walking is the most basic form of travel, and the quality of walking conditions affects other non-auto modes. For example, most public transit travellers, and many rideshare passengers, walk to and from destinations, so improving walking conditions is an important way to increase use of those modes. Completing sidewalk and crosswalk networks, and reducing urban traffic speeds, is one of the most cost-effective and beneficial ways to support TDM.
- Road tolls can reduce vehicle travel and congestion on specific roads, but their overall impacts tend to be modest since they apply to a small portion of total travel.
- Because TDM can provide diverse economic, social and environmental benefits, more comprehensive analysis tends to justify more support for TDM strategies.
- Conventional planning is biased in various ways that favor automobile travel over more affordable and resource-efficient modes. TDM planning requires a paradigm shift from mobility-based to accessibility-based analysis (Levinson and King 2020).
- Freight and service vehicles represent less than 10% of total vehicle travel but because they are large and heavy, these vehicles have relatively large infrastructure costs, congestion, crash risk, energy consumption and pollution emissions. For example, freight transport represents about 30% of carbon emissions.

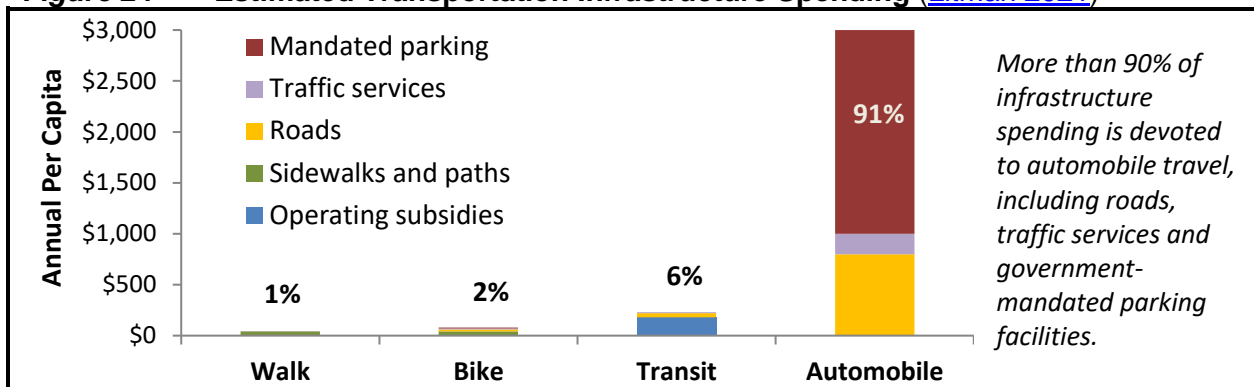
## 9. Conclusions

Transportation demand management encourages travellers to choose the most efficient option for each trip: walking and bicycling for local errands, public transit when travelling on busy corridors, and automobiles when they are truly most efficient overall, considering all benefits and costs. It is comparable to putting the transportation system on a healthier diet. This can provide many direct and indirect benefits.

In the past, transportation professionals considered TDM a solution of last resort, to be implemented only when roadway expansions are infeasible. Most jurisdictions still devote far more resources to road and parking infrastructure than to non-auto modes, as illustrated below, and most zoning codes still mandate abundant parking subsidies and limit infill development. When governments implement TDM programs, they often have limited scope and resources.



**Figure 24** Estimated Transportation Infrastructure Spending (Litman 2021)



There are many reasons for this underinvestment. Practitioners usually evaluate transportation system performance based on automobile travel conditions, using indicators such as roadway level-of-service and congestion delay. Many practitioners are unfamiliar with TDM, and are uncertain of its effectiveness. Many have tried token TDM programs, such as small-scale bicycle and transit improvements, and mode shift promotion campaigns that had little impact. They often conclude that TDM programs are difficult, expensive and ineffective.

This report provides more positive information about TDM effectiveness and benefits. It identifies dozens of successful and cost-effective TDM programs that increase use of resource-efficient modes and reduce automobile travel, often by 10-30%, and even more if integrated with major investments in non-auto modes and Smart Growth development policies. Critics sometimes claim that TDM programs harm travellers by forcing them to use “inferior” modes, but examples in this report indicate that many travellers want alternatives. Although few motorists want to give up driving altogether, many would prefer to drive less and rely on other modes, provided they are convenient, comfortable and affordable. TDM responds to those demands, providing direct benefits to users, plus community benefits from reduced vehicle traffic. Motorists also benefit from reduced traffic and parking congestion, reduced crash risk, and reduced chauffeuring burdens.

To be effective, TDM programs must give travellers incentives to use non-auto modes. As a result, simply improving non-auto modes cause only modest vehicle travel reductions by themselves, but large reduction if implemented with increased fuel prices, parking fees, road tolls, or road space reallocation, such as bus- and bike-lanes, that prioritize non-auto modes over car traffic.

There are, of course, examples of TDM failures. These are typically single interventions with limited support. Success requires integrated programs with adequate investment and well-designed incentives. Although they require significant planning and funding, their costs are usually repaid many times over through user savings and benefits, road and parking cost savings, and reduced traffic problems.

This research indicates that fair and efficient transportation planning invests in TDM first, to maximize total benefits, and only expands roadways as a solution of last resort.

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